

Preface

In September of 1979 the *IBM Journal of Research and Development* published a special issue in which we described some of IBM's contributions to basic laser science and technology over the twenty-year period following invention of the laser in 1960. That involvement has included the invention of new lasers, the development of novel techniques for extending the usable range of wavelengths, and important new advances in spectroscopic tools utilizing lasers.

It has long been recognized that the brightness as well as the spatial and temporal coherence of lasers makes them attractive in applications such as scanners for facsimile terminals, supermarket scanners, electrophotographic printers, interferometric wafer alignment schemes, photochemical synthesis, and spectroscopy. Although work on some of these "first-generation" applications was presented, the primary focus of that issue was basic scientific research.

In this issue, some of the advanced first-generation and second-generation laser applications work of IBM scientists and engineers is presented. These applications have the potential for making a substantial impact on the semiconductor and telecommunications industries.

The extremely localized heat that can be generated by the laser has been used to alter chemical and structural features, and to enhance or induce surface chemical reactions in a wide range of materials. The energetic optical properties of the laser can be harnessed to perform complex, high-resolution lithographic tasks, often without the use of masks

or in isolated or hard-to-reach regions of a circuit. Lasers offer the promise of a means to perform these tasks rapidly, reliably, repetitively, and in a less costly manner. Examples include laser annealing, laser plating and etching, resist exposure, and the repair, personalization, or design change of the increasingly smaller and more complex computer circuits demanded by VLSI technology.

Lasers have also been used in various high-speed, high-resolution schemes involving image projection, electrophotography, nonimpact printing, and scanning; studies continue on the feasibility of their use in optical memory devices. They continue to be used in complex spectroscopic applications because of their ability 1) to be accurately focused to micron and submicron dimensions in the horizontal and vertical (volume) directions; 2) to create high-energy chemistry and physics; and 3) to yield extremely short and rapid pulses of energy, often in a nondestructive fashion. Valuable information has been obtained on traditionally difficult samples such as thin films and polymers, and in narrow interfacial or buried bulk regions, as well as on surfaces. Finally, the laser has also been utilized to study intentionally induced failure modes in order to help workers understand and better prevent breakdowns caused by those failures.

The papers in this issue of the *Journal* represent a sampling of recent applications-oriented laser work at IBM. We believe the work described substantiates the impact of lasers in the computer industry.